KAY

Attenuators

- 432

INSTRUCTION MANUAL
ISSUE F

JUNE 1967

ATTENUATORS

IN-LINE

ROTARY

COAXIAL

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SECTION I
GENERAL INFORMATION

1.1 INTRODUCTION

Kay Attenuators are precision instruments designed to provide an accurate amount of loss in circuits operating in the DC to 4 GHz range. Attenuation up to 132 DB and increments as small as 0.1 DB, can be obtained. All models are symmetrical (bi-directional) attenuators.

Available in two basic configurations; in-line and rotary, a large number of applications are possible. Where space limitations exist, miniature models may be used in place of the standard models.

1.2 CONSTRUCTION

All Attenuators, with the exception of the coaxial and rotary step models, utilize specially developed high-frequency switches. Coin silver contacts set in molded teflon are used for low loss, superior match, and excellent repeatability. The individual steps are isolated in broad tuned, shielded compartments and utilize 1% carbon film precision resistors.

The coaxial models utilize a unique arrangement of switch and "T" pads. This allows the entire assembly to slide in and out of position providing positive switching action.

The rotary step attenuators are constructed using printed circuit techniques to achieve the attenuation. The switching of steps is accomplished thru the use of a spring detent mechanism, furnishing positive selection of attenuation.

1.3 APPLICATIONS

The following are typical applications:

a. As a supplemental attenuator, providing additional attenuation where insufficient attenuation is provided.

b. Replacement for inaccurate instruments.

c. As a vernier attenuator, where large increments are provided or precise calibration is necessary.

d. General purpose attenuator, for instruments without internal attenuation.

e. As a calibration standard.

1.4 RECEIVING AND RESHIPMENT INSTRUCTIONS

When the instrument is initially received a visual check should determine any damage that may have occured during shipment. The most important things to note are the connectors and switch operation.

Should any damage be discovered, please report it immediately to the carrier and to the Kay Electric Company.

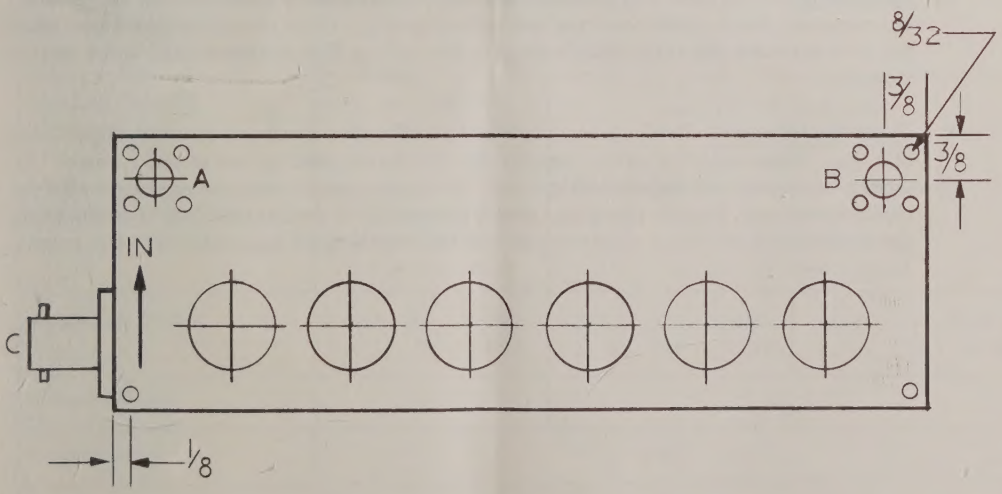
To return an instrument, please obtain permission from the factory or a Kay representative before doing so. To aid the service personnel, include the serial number and the defect on the packing slip.

1.5 SPECIAL APPLICATIONS

To allow more varied applications, most Kay in-line attenuators are available in special configurations. These special units are suited for panel mounting or inclusion in a wide variety of test equipment.

These models are designed to be mounted as shown with four mounting holes tapped for an 8/32 by 3/8 inch machine screw centered 1/8 inch from each edge. Connector mounting is optional and may be placed as indicated by "A", "B", "C".

These special model attenuators have the same specifications as the standard units up to 500 MHz and are useful to 1000 MHz.



SERIES "KS" PANEL MOUNTED ATTENUATORS

SECTION II

IN-LINE ATTENUATORS

2.1 INTRODUCTION:

These attenuators are assembled in lightweight castings with separate, silver-plated compartments for the switches. The individual attenuator sections are connected in series and are additive as the switches are placed in the UP position.

2.2 OPERATING INSTRUCTIONS:

A. To avoid producing spurious losses through impedance mismatch, all input and output connections should be made using the proper impedance plugs. All cabling should also be of the correct impedance.

B. The attenuators constitute a direct DC path and do not include internal protective devices in the form of fuses, decoupling capacitors, etc. To avoid damage to precision components, do not apply signals greater than that specified for the unit.

C. When using the 20 Series attenuator with fixed 10 DB of loss, this must be added to all values of switchable attenuation.

2.3 GENERAL MAINTENANCE INFORMATION:

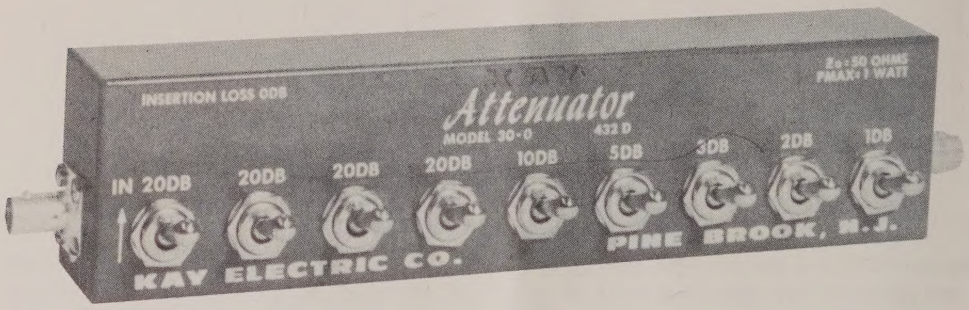
A. Disassembly - The case may be opened for inspection and service of internal components by removing the screws securing the bottom cover. Care should be exercised when unsoldering connections to avoid damage to the carbon film resistors and teflon switch mounts.

B. Parts Replacement - Replacement parts and switches are available from the Kay Electric Co. When ordering parts, specify the attenuator catalog and model number. To insure accuracy and dependability, only identical components are recommended for replacement use. Proper electrical performance will be maintained only if components are replaced in the same position and with the lead lengths approximately the same.

Series 20: Catalog Nos. 431C, 441C, 451C.

These attenuators provide 41DB of attenuation in 6 steps of 20, 10, 5, 3, 2 and 1 DB. This series is available in characteristic impedances of 50, 75, and 90 ohms. A model with up to 51DB including 10DB fixed insertion loss is also available.

SERIES	20-0	21-0	22-0
Catalog No.	431C	441C	451C
Characteristic Impedance	50	75	90
Freq. Range	DC - 1GHz	DC - 500MHz	
Attenuation Range	0 - 41DB		
Attenuation Steps	6 Steps 1, 2, 3, 5, 10, 20		
Typical Overall Accuracy (±)	0.5, 0 - .25 GHz 0.9, .25 - .5 GHz 1.2, .5 - 1GHz	.5DB : 0 - .25 GHz 1.2DB: .25 - .5 GHz	
Insertion Loss (DB)	0 - .25 GHz, ≤ .1 .25 - .5 GHz, ≤ .1 .5 - 1GHz, ≤ .5	0 - .25 GHz : ≤ .1 .25 - .5 GHz : ≤ .2	
Maximum VSWR	1.2:1, 0 - .25 GHz 1.4:1, .25 - 1GHz	1.2:1, 0 - .25 GHz 1.4:1, .25 - .5 GHz	1.3:1, 0 - .25 GHz 1.5:1, .25 - .5 GHz
Power (Watts)	1	½	
Connectors	BNC		
Controls	Toggle-Switch		
Dimensions	2 x 7 x 2		
Weight	2 lbs.		



Series 30: Catalog Nos. 432D, 442C, 452C.

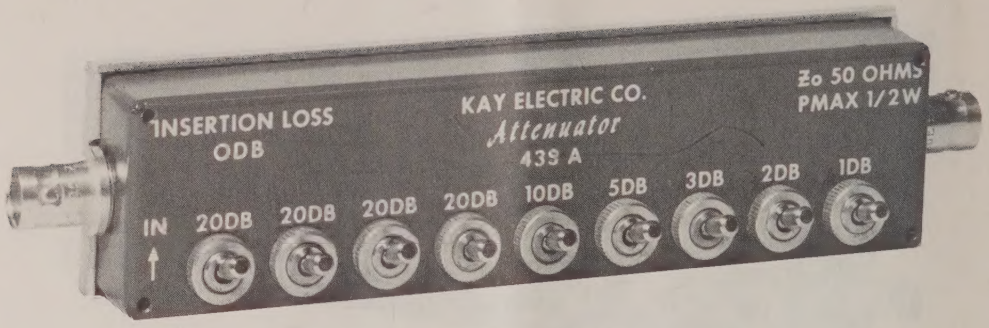
The Series 30 attenuators furnish 101 DB of attenuation in 9 steps; 20, 20, 20, 20, 10, 5, 3, 2, and 1 DB. These attenuators provide the large amounts of attenuation necessary for all applications where accuracy and repeatibility are important. Available in impedances of 50, 75 and 90 ohms, this series is an ideal general purpose instrument.

SERIES	30-0	31-0	32-0
Catalog No.	432D	442C	452C
Characteristic Impedance	50	75	90
Freq. Range	DC - 1 GHz	DC - 500 MHz +	
Attenuation Range	0 - 101 DB		
Attenuation Steps	9 Steps 20, 20, 20, 20, 10, 5, 3, 2, 1		
Typical Overall Accuracy (±)	0.6 DB : 0 - .25 GHz 1.2 DB : .25 - .5 GHz 2.0 DB : .5 - 1 GHz	1.0 DB : 0 - .25 GHz 2.0 DB : 0 - .5 GHz	
Insertion Loss (DB)	0 - .25 GHz - ≤.1 .25 - .5 GHz - ≤.2 .5 - 1 GHz - ≤.6	0 - .25 GHz : ≤.1 .25 - .5 GHz : ≤.2	
Maximum VSWR	1.2:1, 0 - .25 GHz 1.4:1, .25 - 1 GHz	1.2:1, 0 - .25 GHz 1.4:1, .25 - .5 GHz	1.3:1, 0 - .25 GHz 1.5:1, .25 - .5 GHz
Power (Watts)	1	½	½
Connectors	BNC		
Controls	Toggle-Switch		
Dimensions	2 x 9 3/4 x 2		
Weight	3 lbs.		

Series 70: Catalog Nos. 1/432C, 1/442C, 1/452C.

The series 70 models are vernier attenuators which provide fine control of attenuation when used separately or as a supplemental unit. 22.1 DB of attenuation is provided in steps of 0.1, 0.2, 0.3, 0.5, 1, 2, 3, 5, 10 DB.

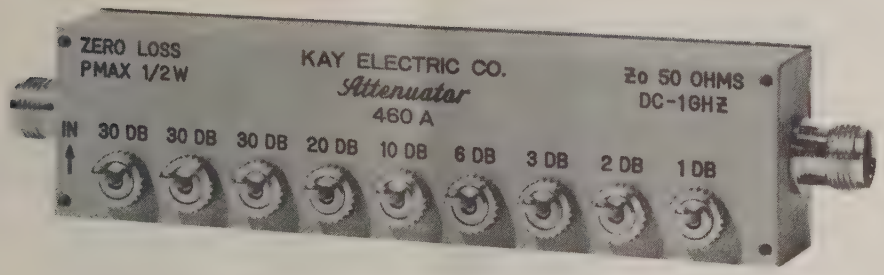
SERIES	70-0	71-0	72-0
Catalog No.	1/432C	1/442C	1/452C
Characteristic Impedance	50	75	90
Freq. Range	DC - .25 GHz		
Attenuation Range	0 - 22.1 DB		
Attenuation Steps	9 Steps .1, .2, .3, .5, 1, 2, 3, 5, 10		
Typical Overall Accuracy (±)	.5 DB at .25 GHz	5% at .1 GHz 10% at .25 GHz	
Insertion Loss (DB)	0 - .25 GHz - ≤.1		
Maximum VSWR	1.2:1, 0 - .25 GHz	1.4:1, 0 - .25 GHz	
Power (Watts)	1		
Connectors	BNC		
Controls	Toggle-Switch		
Dimensions	2 x 9 3/4 x 2		
Weight	3 lbs.		



Series 90: Catalog Nos. 439A, 449A, 459A.

The 90 series is a miniature version of the 30 series. Attenuation from zero to 101 DB in 9 steps is provided. This attenuator is designed primarily for applications where space limitations are a problem.

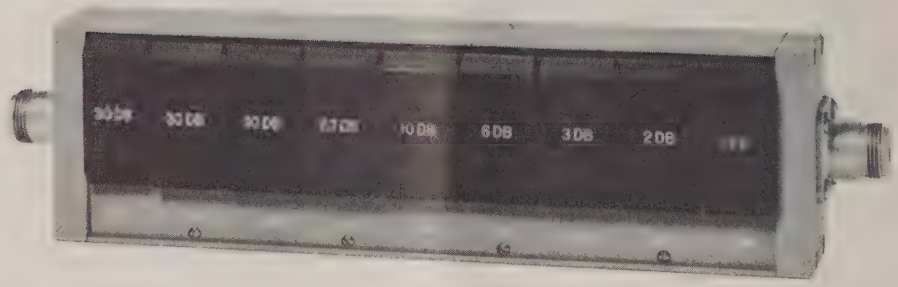
SERIES	90-0	91-0	92-0
Catalog No.	439A	449A	459A
Characteristic Impedance	50Ω	75Ω	90Ω
Frequency Range	DC - 1 GHz	DC - .5 GHz	
Attenuation Range	0-101 DB		
Attenuation Steps	9 Steps 1, 2, 3, 5, 10, 20, 20, 20, 20		
Typical Overall Accuracy (±)	.6 DB, 0 - .5 GHz 1.5 DB, .5 - 1 GHz	1.0 DB, 0 - .25 GHz 2.0 DB, .25 - .5 GHz	
Insertion Loss (DB)	0 - .25 GHz ≤ .05 .25 - .5 GHz ≤ .2 .5 - 1 GHz ≤ .5	0 - .25 GHz ≤ .1 .25 - .5 GHz ≤ .2	
Maximum VSWR	1.2:1, 0 - 5 GHz 1.4:1, .5 - 1 GHz	1.2:1, 0 - .25 GHz 1.4:1, .25 - .5 GHz	1.3:1, 0 - .25 GHz 1.5:1, .25 - .5 GHz
Power (Watts)	1	½	
Connectors	BNC		
Controls	Toggle-Switch		
Dimensions	1¼ x 6¼ x 7/8		
Weight	8 oz.		



Series 100: Catalog No. 460A.

The Miniature Series 100 Attenuators provide attenuation from zero to 132 DB. Designed primarily for applications where space limitations exist, the Series 100 furnishes high accuracy and a compact instrument over a wide frequency range.

SERIES	100
Catalog No.	460A
Characteristic Impedance	50 Ω
Frequency Range	DC - 1 GHz
Attenuation Range	0 - 132 DB
Attenuation Steps	9 Steps 1, 2, 3, 6, 10, 20, 30, 30, 30
Typical Overall Accuracy (±)	.05 DB: 0 - .25 - .25 GHz .2 DB: .25 - .5 GHz .5 DB: .5 - 1 GHz
Insertion Loss	0 - .25 GHz, ≤ .05 .25 - .5 GHz, ≤ .2 .5 - 1 GHz, ≤ .5
Maximum VSWR	1.2:1, 0.5 GHz 1.4:1, .5 - 1 GHz
Power (Watts)	$\frac{1}{2}$
Connectors	TNC
Controls	Toggle-Switch
Dimensions	1 3/8" x 6 1/8" x 7/8"
Weight	8 oz.



Series 110: Catalog No. 461A.

The Series 110 is a high frequency coaxial attenuator. The 110 operates in a range from DC to 4 GHz. The sliding block switch arrangement controls up to 132 DB with positive in-out action for accuracy and repeatability.

CATALOG NO.:	461-A	
FREQUENCY RANGE:	DC to 4 GHz	
ATTENUATION STEPS: DB	9 Steps 1, 2, 3, 6, 10, 20, 30, 30, 30	
CONTROLS:	Slide Switches	
TYPICAL OVERALL ACCURACY (±):	0-6 DB	0-132 DB
	DC to 1 GHz - .3 DB	2% ±.2DB up to a maximum of 1.0DB
	1 to 2 GHz - .3 DB	2% ±.3DB up to a maximum of 1.5DB
	2 to 3 GHz - .4 DB	3% ±.2DB up to a maximum of 3.0DB
	At 4 GHz - .5DB	5% ±.3DB up to a maximum of 5.0DB
MAXIMUM VSWR:	D.C. to 1 GHz	1.15:1
	1 to 2 GHz	1.3:1
	2 to 3 GHz	1.5:1
	At 4 GHz	1.9:1
TYPICAL INSERTION LOSS:	At 1 GHz ≤ .2 DB At 2 GHz ≤ .4 DB At 3 GHz ≤ .5 DB At 4 GHz ≤ .6 DB	
POWER: (Watts)	1	
DIMENSIONS:	8 3/8 x 2 3/8 x 1 5/8	

SECTION III

ROTARY ATTENUATORS

3.1 INTRODUCTION:

Kay rotary attenuators are divided into two-types; Dual-Rotary and Rotary Step.

The Dual-Rotary Attenuators furnish up to 119 DB. Following the proven techniques used in Kay in-line models, the steps are mounted in individual compartments. Constructed using only precision components and high frequency switches, these units provide accuracy, repeatability and are quite rugged.

The Rotary-Step Models provide up to 60 DB of attenuation. They use a printed circuit type rotary switch and ball-detent mechanism to provide positive switching.

3.2 OPERATING INSTRUCTIONS:

A. To avoid producing spurious losses through impedance mismatch, all input and output connections should be made using the proper impedance plugs. All cabling should also be of the correct impedance.

B. The attenuators constitute a direct DC path and do not include internal protective devices in the form of fuses, decoupling capacitors, etc. To avoid damage to precision components, do not apply signals greater than that specified for the unit.

3.3 GENERAL MAINTENANCE INFORMATION:

A. Disassembly -

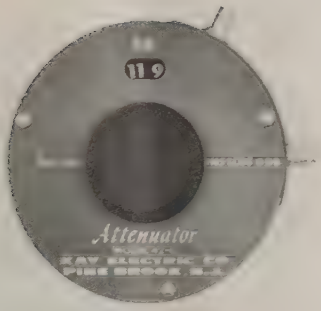
a. Series 40
1. Remove the three 6-32 machine screws from the bottom of the cover.
2. Remove the ground screws located below the input and output connectors.
3. Grasp the top section in one hand and the bottom in the other and carefully pull the two apart.

b. Series 50
1. Remove top cover. This exposes the cam arrangement for alignment.
2. Turn both shafts until all toggle switches point away from the cams: this indicates zero attenuation.
3. Set both dials on the shaft.
4. Turn dials to 00 and tighten set screws.
5. Electrical maintenance is the same as for in-line attenuators.

c. Series 60
1. Carefully remove the TNC connectors.
2. Remove the three screws from the front of the unit.
3. Slide the attenuator apart carefully so as not to damage the ground contacts.
4. To reassemble, using extreme care not to damage the spring contacts, slide

the attenuator into the case and re-install the TNC connectors.

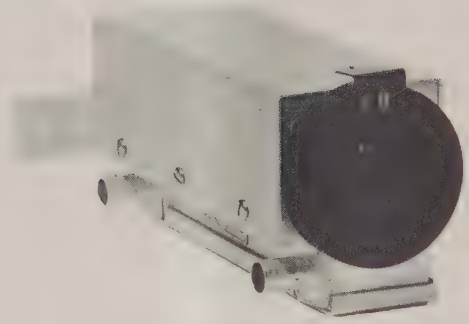
B. Parts Replacement - Replacement parts and switches are available from the Kay Electric Co. When ordering parts, specify the attenuator catalog and model number. To insure accuracy and dependability, only identical components are recommended for replacement use. Proper electrical performance will be maintained only if components are replaced in the same position and with the lead lengths approximately the same.



Series 40: Catalog No. 433A.

The Series 40 attenuator is a direct-reading digital device. These units are contained in silver plated brass housings to provide rugged stable assemblies. Attenuation range is controlled by a dual-rotary switching arrangement providing steps of 10 DB and 1 DB up to a total of 119 DB.

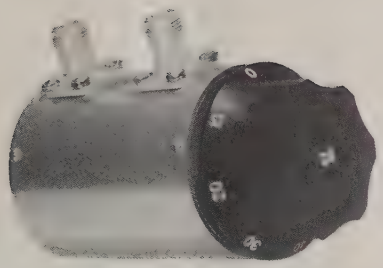
SERIES	40
Catalog	433A
Characteristic Impedance	50 Ω
Frequency Range	DC - 500 MHz +
Attenuation Range	0 - 119 DB
Attenuation Steps	9 Steps, 10 DB ea. 11 Steps, 10 DB ea.
Typical Overall Accuracy (±)	.6 DB : 0 - .25 GHz 1.2 DB : .25 - .5 GHz
Insertion Loss (DB)	0 - .25 GHz : ≤ .1 .25 - .5 GHz : ≤ .2
Maximum VSWR	1.2:1, 0 - .25 GHz 1.4:1, .25 - .5 GHz
Power	$\frac{1}{2}$
Connectors	BNC
Controls	Dual-Rotary
Dimensions	5" Dia x $2\frac{1}{4}$"
Weight	3 lbs. 8 oz.



Series 50: Catalog Nos. 434A, 444A, 454A.

The series 50 attenuator is a dual-rotary unit using a miniature in-line attenuator controlled by a cam operated switching arrangement. A range of attenuation from zero to 99 DB is provided in 1 DB steps.

SERIES	50-0	51-0	52-0
Catalog No.	434A	444A	454A
Characteristic Impedance	50	75	90
Freq. Range	DC - .5 GHz		
Attenuation Range	0-99 DB		
Attenuation Steps	9 Steps, 1 DB ea. 9 Steps, 10 DB ea.		
Typical Overall Accuracy (±)	.6 DB, 0 - .5 GHz 1.5 DB, .5 - 1 GHz	1.0 DB, 0 - .25 GHz 2.0 DB, .25 - .5 GHz	
Insertion Loss (DB)	0 - .25 GHz ≤ .05 .25 - .5 GHz ≤ .2 .5 - 1 GHz ≤ .5	0 - .25 GHz ≤ .1 .25 - .5 GHz ≤ .2	
Maximum VSWR	1.2:1, 0 - .5 GHz 1.4:1, .5 - 1 GHz	1.2:1, 0 - .25 GHz 1.4:1, .25 - .5 GHz	1.3:1, 0 - .25 GHz 1.5:1, .25 - .5 GHz
Power (Watts)	1	½	
Connectors	BNC		
Controls	Dual-Rotary		
Dimensions	2¼ x 2 x 5 3/4		
Weight	2 lbs.		



Series 60: Catalog Nos. 435A, 436A, 1/435A.

The Series 60 Attenuator uses a unique rotary switch arrangement to provide attenuation up to 60 DB. Increments as small as 0.1 DB and as large as 10 DB are available. These compact units are designed primarily for panel mounting.

SERIES	60-0	60-1	60-01
Catalog No.	435A	436A	1/435A
Characteristic Impedance	50Ω		
Frequency Range	DC - 1.3 GHz		
Attenuation Range	0-10, 1 DB steps	0-60, 10 DB steps	0-1, 0.1 DB steps
Attenuation Steps	10 Steps 1, 2, 3, 4, 5, 6, 7, 8, 9, 10	6 Steps 10, 20, 30, 40, 50, 60	10 Steps .1, .2, .3, .4, .5, .6, .7, .8, .9, 1.0
Typical Overall Accuracy (±)	.2 DB: 0-.3 GHz .3 DB: .3-1 GHz	2% at .3 GHz 5% at 1 GHz	.025 DB, 0-.5 GHz 10% +.05, 5 - 1 GHz
Insertion Loss (DB)	0 - .25 GHz ≤ .1 .25 - .5 GHz ≤ .1 .5 - 1 GHz ≤ .2		0 - .25 GHz ≤ .1 .25 - .5 GHz ≤ .1 .5 - 1 GHz ≤ .1
Maximum VSWR	1.1:1, 0 - .3 GHz 1.3:1, .3 - 1 GHz		1.1:1, 0 - .3 GHz 1.4:1, .3 - 1 GHz
Power (Watts)	1	$\frac{1}{2}$	1
Connectors	TNC		
Controls	Rotary, step		
Dimensions	2 Dia x 2 1/8		
Weight	1 lb.		

SECTION IV

TEST PROCEDURE

4.1 INTRODUCTION:

This test procedure will allow the operator to perform a complete, factory-type check of the instrument. This information will be especially helpful whenever repairs have been made or the unit is initally received.

To insure accurate results, the test set-up should be free from stray radiation. The use of correct impedance connectors is extremely important.

4.2 EQUIPMENT REQUIRED:

Oscilloscope - Tektronix type 503, or equivalent
Loss Measurement Receiver- Kay Gain Set 620-A, or equivalent
Sweep Generator - Kay Model 121-C, or equivalent
C-W Signal Generator - General Radio Type 1209-B, or equivalent
C-W Signal Generator - Kay Utilator, or equivalent
C-W Signal Generator - General Radio Type 1218-A
Terminations - Applied Research Inc, impedance to match unit under test.
VSWR Standard - 1.1:1, 1.2:1, 1.5:1
Attenuation Pads - General Radio,10DB
Mixer - See Fig. 4.1
Detector - See Fig. 4.2

4.3 70MHz CHECK

a. Interconnect equipment as shown in Fig. 4.3
b. Set Utilator control for 70MHz.
c. Insert an amount of DB into Gain Set Attenuator equal to amount of attenuator being tested.
d. Adjust output of Utilator and the Gain Control of the Gain Set Amplifier Detector to obtain a zero reading on the Gain Set output meter.
e. Insert a step of attenuation from the attenuator under test and remove an equal value from the Gain Set. The Gain Set meter will indicate the error. Repeat for each step and add the errors algebraically. The total should not exceed the value specified for the attenuator.

4.4 INSERTION LOSS CHECK AT 70MHz

a. Remove all attenuation from unit being tested.
b. Zero the Gain Set meter as described in 4.3D above.
c. Remove attenuator under test and substitute a BNC double female connector in its place.
d. The insertion loss read from Gain Set meter should not exceed specified limit.

4.5 250 MHz CHECK

a. Interconnect equipment as shown in Fig. 4.4
b. Set the output of one GR-1209-B at 250 MHz.
c. Set the output of the other GR-1209-B at 320 MHz.
d. Readjust the 320 MHz oscillator frequency until a peak reading is obtained on the Gain Set meter.
e. Insert attenuation in Gain Set attenuator equal to that of test attenuator. All attenuation should be removed from unit under test.
f. Adjust 320 MHz oscillator output level and the Gain Set Gain Control for a zero reading on the Gain Set meter.
g. Repeat step 4.3 e above.

4.6 INSERTION LOSS CHECK AT 250 MHz

a. Repeat procedure 4.4 using test set-up for 250 MHz check.

4.7 500 MHz CHECK

a. Interconnect equipment as shown in Fig. 4.4
b. Set output frequency of one GR-1209-B at 500 MHz.
c. Set output frequency of the other GR-1209-B at 570 MHz.
d. Adjust output frequency for a peak reading on the Gain Set meter.
e. Repeat steps 4.5 (e) (f) (g).

4.8 1 GHz CHECK

a. Interconnect the equipment as shown in Fig. 4.4
b. Set the output frequency of the GR-1209-B to 930 MHz.
c. Set the output frequency of the GR-1218-A to 1000 MHz.
d. Readjust for a peak reading on Gain Set meter.
e. Insert attenuation in Gain Set equal to unit under test.
f. Check accuracy by repeating steps 4.5 (e) (f) (g).

4.9 VSWR CHECK

1. a. Interconnect equipment as shown in Fig. 4.5
(Use SWEEP function of 121-C at maximum sweep width.)
b. Tune the output frequency of the 121-C to point of greatest mismatch.
c. Establish a scope reference scale (such as 1 cm = 1).
d. Adjust the vertical gain of the scope so that the vertical distance between the baseline and the negative peaks of the standing wave (dimension a, Fig. 4.6) is equal to the reference scale.
e. Determine the distance between the baseline and the positive peaks of the standing wave (dimension b, Fig. 4.6) using reference scale.
f. The VSWR will be equal to the deflection obtained in 4.9 e divided by the reference established in 4.9 c. VSWR should equal that stated in specifications of unit under test.

2. a. Interconnect as in Fig. 4.4
   b. Substitute a known mismatch for the attenuator (available as 1:2:1, 1:5:1, etc.). Note the VSWR on the oscilloscope.
   c. Replace the attenuator in the test set-up.
   d. The attenuator should not exceed the known VSWR.

3. If equipment for performing the previous checks is not available, a slotted line and appropriate techniques will provide acceptable results.

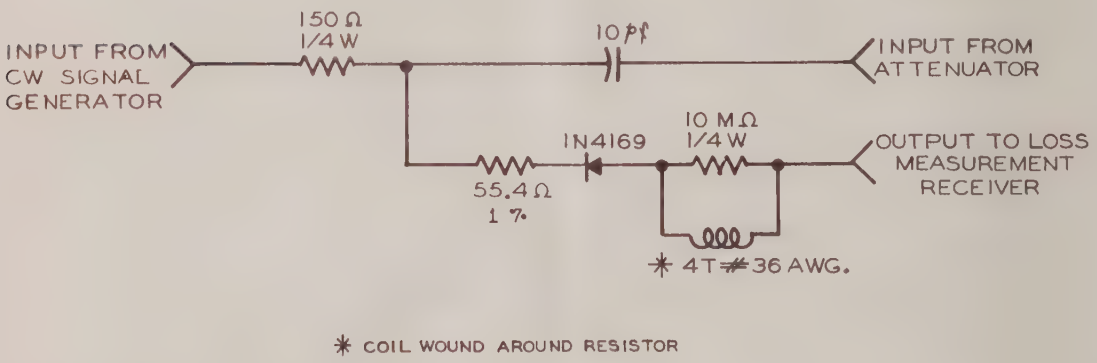


FIG. 4.1

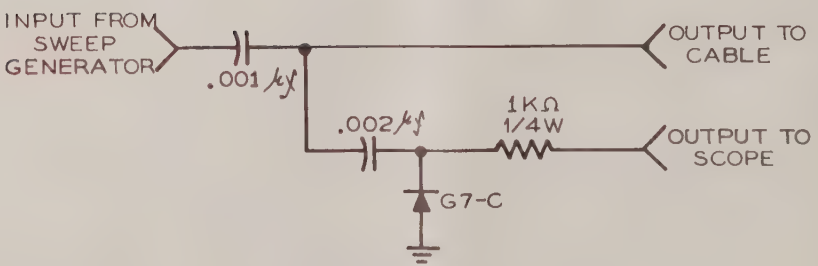


FIG. 4.2

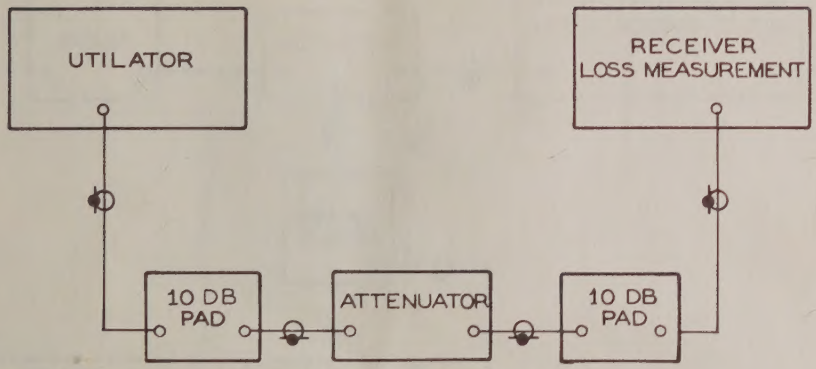

UTILATOR
RECEIVER
LOSS MEASUREMENT
10 DB
PAD
ATTENUATOR
10 DB
PAD

FIG. 4.3

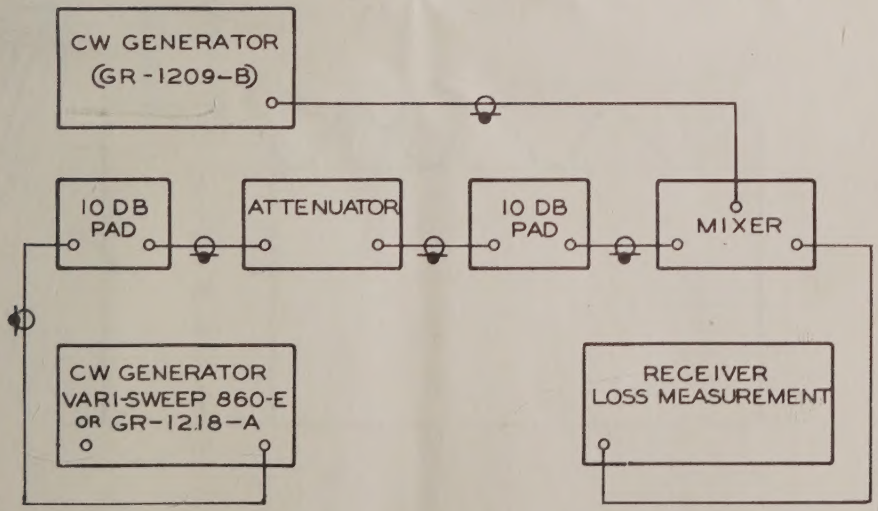

CW GENERATOR
(GR-1209-B)
10 DB
PAD
ATTENUATOR
10 DB
PAD
MIXER
CW GENERATOR
VARI-SWEEP 860-E
OR GR-1218-A
RECEIVER
LOSS MEASUREMENT

FIG. 4.4

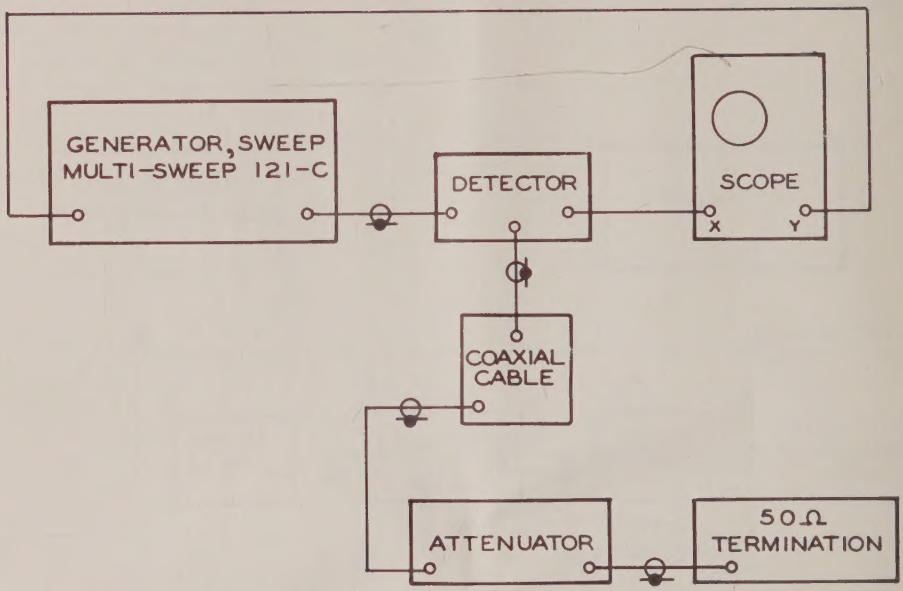
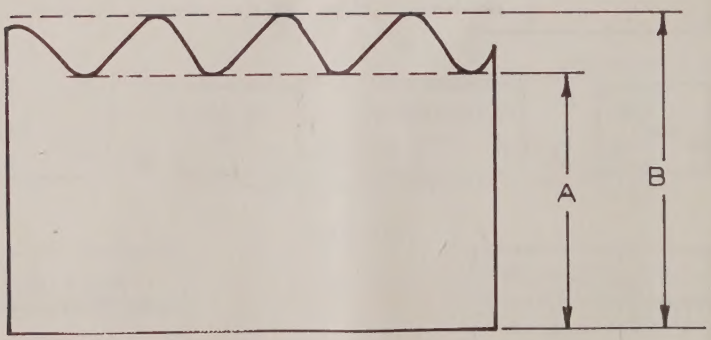


FIG. 4.5



MEASUREMENT OF VSWR

FIG. 4.6

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